Treatment of Cord Bladder Incontinence in Children *

ORVAR SWENSON, M.D., JOHN H. FISHER, M.D., JEAN CENDRON, M.D.
Boston, Massachusetts

URINARY INCONTINENCE in children with cord bladder has been relatively neglected. In contrast Munro has outlined treatment that achieves continence in a large percentage of adults with cord bladders.[1-3] Myelomeningocele involves a more extensive area of cord and sacral roots at a lower level than the traumatic lumbar cord injury commonly seen in adult patients. This is probably the reason that the routine form of treatment so successful in adults has not proved effective in establishing urinary continence in children. Neurosurgeons today are more skillful than formerly in correcting myelomeningoceles so that lethal cerebrospinal infections are a decreasing hazard. Orthopedic surgeons are more successful in making these patients ambulatory both by reconstructive procedures and with the use of appliances. Consequently a larger number of these children are surviving, healthy and ambulatory but with urinary incontinence. Because of anal incontinence ureterosigmoidostomy is impractical. An isolated segment of ileum can be used as a conduit between the ureters and the skin and an ileostomy bag glued to the skin as a receptacle. This arrangement entails problems invariably associated with a skin attached urinal bag such as leaks from failure of the skin glue.

Generally in the adult with a lumbar spinal cord lesion the bladder has a normal intravesical pressure with effective detrusor contractions. In our group of 20 children with cord lesions and urinary incontinence, three have been of this type. By a program of treatment, essentially as Munro has used, these three children have become continent. The variation has been that tidal irrigation has been used at night with the catheter draining into a rubber urinal attached to the leg during the day. This regimen permits the children to engage in normal activity, to live at home, and the nightly use of the Munro irrigation has maintained adequate bladder capacity.

Seventeen out of our 20 children had cord bladders resulting from low myelomeningocele. These have had lesions involving the sacral roots and presumably for this reason did not gain continence despite prolonged use of tidal irrigation and training. Cord bladder in a child with a low myelomeningocele has three major functional defects. In the first place it is erroneous to assume that dribbling denotes a low intravesical pressure. This is usually not the case, for frequently dribbling does not commence until the intravesical pressure is 25 cm. of water or more. In such children there is a constant pressure in the bladder which approaches the ureteral peristaltic pressure of 35 cm. of water, and in addition, frequent detrusor contractions with elevation of pressure to 50 to 80 cm. of water (Fig. 1). Under such conditions progressive dilatation of the ureters and increasing hydronephrosis are inevitable. Severe diminution in renal function follows and this is the cause of death in the majority of such children. The high intravesical pressure and frequent purposeless detrusor contractions have been a perplexing problem, and considerable efforts have been expended in attempting to denervate the bladder to reduce the pressure. So far no procedure has been found that would achieve the desired result. Banthine® (Methanthe-

* Presented before the American Surgical Association, White Sulphur Springs, West Virginia, April 11, 1956.

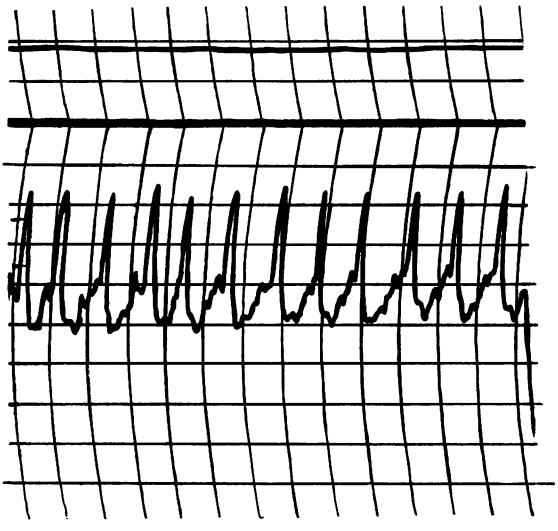

FIG. 1. A normal ureteral peristalsis tracing. Thirty-five centimeters of water pressure is developed. Contractions occur at fifteen second intervals.

line Bromide), a parasympathetic blocking agent, has a specific depressant effect on the bladder detrusor muscle action (Fig. 2). This is one of the most specific effects of this drug, and we have found it to be most useful in reducing intravesical pressure to normal levels (below 20 cm. of water) and preventing frequent detrusor contractions in cord bladders resulting from low myelomeningoceles. The drug is well-tolerated and usually one dose (50 mg.) is effective for a 24-hour-period. There have been no untoward reactions with the use of this drug over long periods of time. In some patients, with this hypertensive type of cord bladder it is possible to achieve continence with the use of Banthine® alone.

The second problem with this form of cord bladder is that, though dribbling occurs, there is frequently a considerable volume of residual urine in the bladder after emptying which causes recurrent bouts of infection. Plastic procedures on the bladder neck are useful in reducing the residual volumes of urine in the bladder to below 20 ml. The third problem is that despite the use of Banthine® and bladder neck resection some patients continue to dribble.

These general considerations have guided our mode of caring for children with cord bladder. In the small infant manual compression of the bladder at regular intervals may be successful. Should urograms at six months or thereafter outline dilatation of the upper urinary tract or should urinary infection develop this treatment is abandoned and a urethral catheter inserted. Children two to three years of age do not tolerate bladder compression and for this reason a catheter may be required. Foley type catheters are used and during the day connected to a rubber urinal attached to the leg. This permits the children to remain dry and to be normally active. At night the catheter is attached to a Munro irrigation set, and this maintains a bladder capacity of 100 or 200 ml. Furthermore, with this program a low bladder pressure is assured which protects the upper urinary tract. Some children with hydronephrosis and megaloureters have had a return to normal contour of the upper urinary tract with this treatment (Fig. 3). Aspirin, 10 grains, three times a day and cranberry juice 750 ml. a day are helpful in reducing incrustations on the catheter. Such a program makes it possible to prolong the period between catheter changes to six weeks.

When the children with hypertonic bladders are eight to ten years of age, tests with Banthine are made. In one patient regular use of this drug has been sufficient to establish continence. Needless to say the child has to be cooperative and make a determined effort to empty the bladder at three hour intervals and once at night, and the emptying must be complete so that the residual urine is not over 20 ml. These considerations make it advantageous to postpone this part of the program until the child is eight to ten years of age.

Repeated tests are made of residual volumes of urine after voiding. Volumes greater than 20 ml. require bladder neck resection or a plastic to the bladder neck. We have found that a 3 cm. verticle inci-

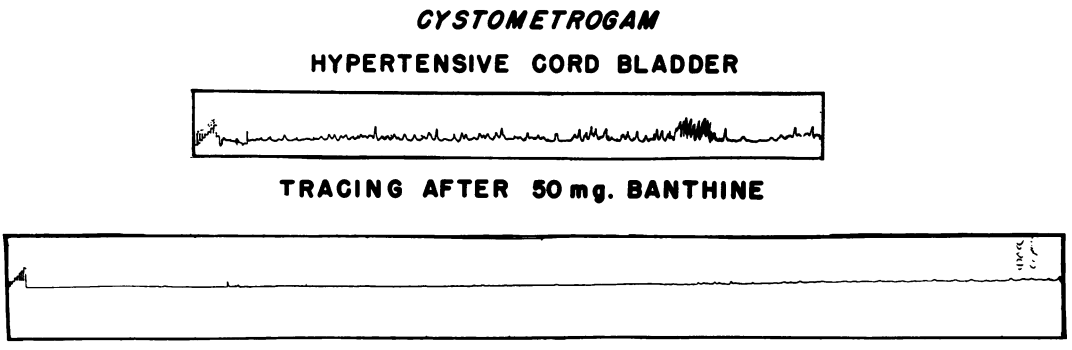

FIG. 2. Cystometrogram of 13-year-old girl with repaired myelomeningocele and cord bladder. This tracing which demonstrates the high intravesical pressure and frequent detrusor contractions is typical of children with cord bladder. A repeat tracing after 50 mgm. of Banthine shows the effectiveness of this drug in reducing the intravesical pressure and preventing useless detrusor contractions.

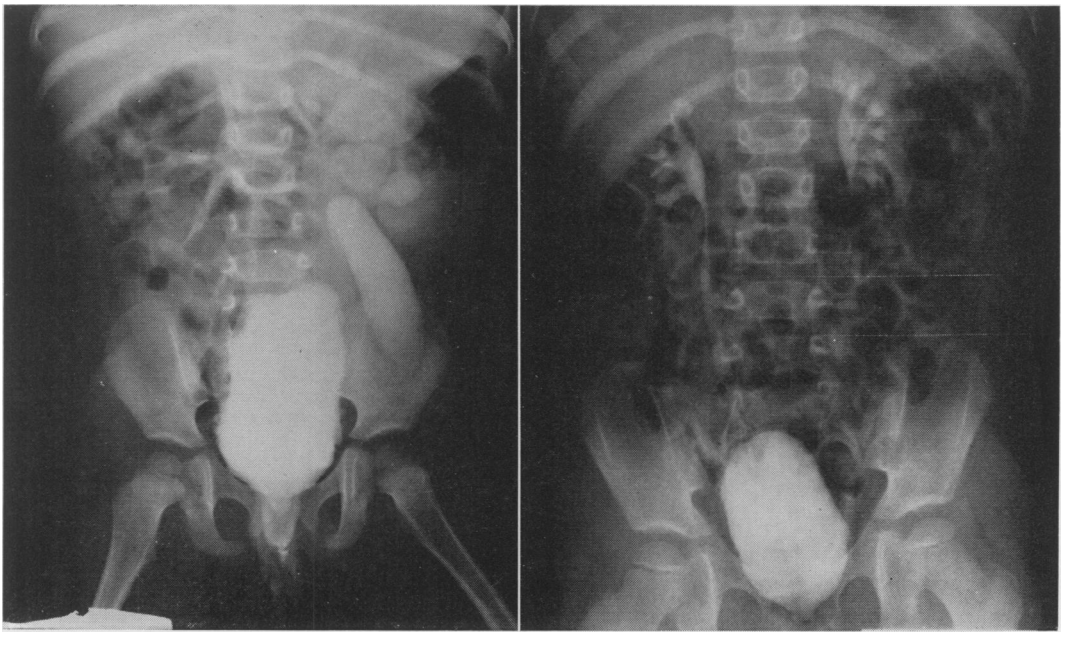

FIG. 3. A. Urogram on a child with cord bladder prior to treatment. Note extensive dilatation of upper urinary tract. B. Urogram two years after catheter and irrigator treatment was instituted.

sion from the urethra to the bladder through the muscular coats and suturing this incision in the horizontal plane is most effective in reducing residual volumes of urine to normal. Two patients with the use of Banthine and a plastic to the bladder neck have become continent. In three patients there has been constant dribbling after this procedure.

The hope of making these children continent would require a device by which the urethra could be blocked at will to prevent escape of urine and opened to permit bladder emptying. Such a device must be outside the urinary system for any material inside the urethra or bladder would be a cause of urinary infection.

It was in the hope of providing a new

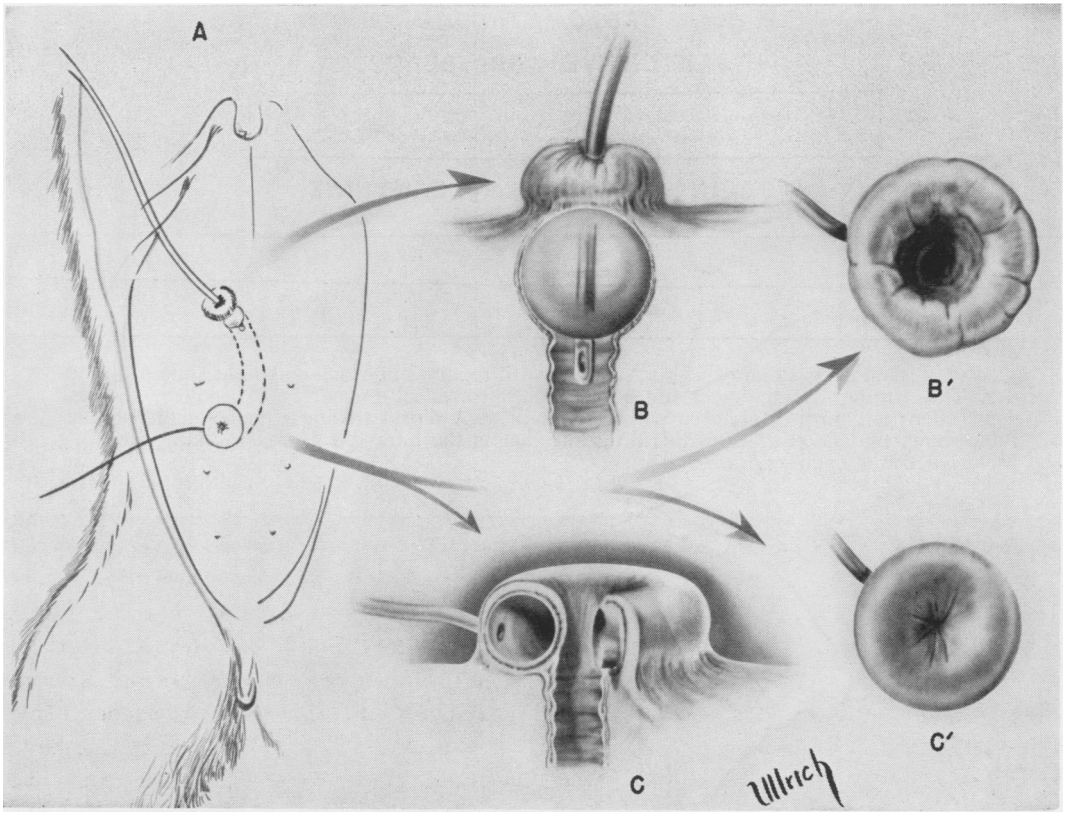

FIG. 4. A. Schematic dawing depicting the use of an isolated ileal loop to test the effectiveness of a pneumatic sphincter. C. A skin line tube is constructed around the distal ileostomy; a rubber inflatable cuff is inserted inside this skin tube. C'. Inflation of this rubber cuff occludes the distal ileostomy. B'. Deflation of the rubber cuff opens the ileostomy. B. The effectiveness of this occlusion was tested by instilling fluid into the isolated loop with controlled pressure.

approach to this problem, particularly in the female, that the following experiments were performed in the laboratory. In eight dogs a segment of ileum was isolated and the ends exteriorized on the abdominal wall. Intestinal continuity was restored by end-to-end anastomosis. A skin-line tube was constructed around the distal end of the isolated segment in the abdominal wall. Several weeks later an inflatable rubber cuff was inserted through the skin-line tube. Injection of air into this collar would occlude the lumen of the intestine. A Foley catheter was inserted in the proximal end of the freed loop so that fluid under controlled pressures could be injected into the isolated segment (Fig. 4). These experiments demonstrated that pressures up to 50 or 60 cm. of water in the intestine could be prevented from leaking out the distal end with the rubber collar inflated. Periods of occlusion of six to twelve hours were used and no evidence of necrosis of the skin tube or intestine was found. The principle of the inflatable cuff or concealed pneumatic sphincter was further tested on six female animals in the following way. The perineum of these animals was divided down to the rectum in order to expose the anterior vaginal wall. Two incisions parallel to and on each side of the urethra were made. A dissection around the urethra was performed and vaginal mucosa was brought behind the urethra and sutured in place so that a space was provided for an inflatable rubber cuff to be placed around the

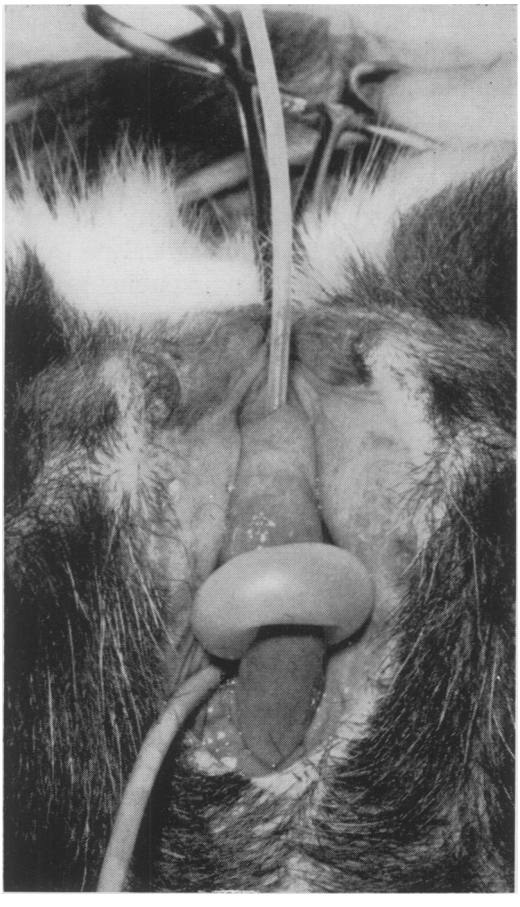

FIG. 5. A photograph of a rubber cuff about the urethra in an experimental animal.

urethra (Fig. 5). Tests were made on these animals by inserting a small polyethylene tube through the urethra into the bladder. This provided a means to control and measure the pressure within the bladder. The pneumatic cuff was effective in controlling the flow of water from the bladder with intravesical pressures up to 60 cm. of water. This was accomplished without damage to either the urethra or the vaginal mucosa by the inflated cuff. The rubber cuff while around the urethra was not a source of infection for it occupied a space lined by vaginal mucosa and actually was outside the body. These experiments indicated that it might be possible to utilize this principle in some types of patients with urinary incontinence.

In the three patients who dribble despite Banthine and bladder neck resection a new procedure based on our laboratory work has been used. It was postulated that a skin graft could be placed around the urethra and that an inflatable rubber cuff could be inserted inside the skin tube and used to block the urethra. In the first patient, a boy, this was accomplished with a Thiersch graft wrapped on a Penrose drain and inserted around the perineal urethra. The result was unsatisfactory due to a fistula between the skin tube and urethra. This experience indicated that the membranous urethra was delicate and could not be encircled by a Thiersch graft without possibility of fistula formation. The posterior urethra at the bladder neck is sturdier and more richly vascularized than the membranous urethra. This prompted us to encircle the urethra with a Thiersch graft at that level and this has been accomplished in two patients. In both a suprapubic incision was used and the skin graft was brought to the skin surface at the incision. This operation provided a skin lined space around the urethra which opened onto the suprapubic skin surface. An inflatable rubber cuff was inserted into this skin lined space around the urethra. A small rubber tube connected with the rubber cuff and transversed the skin lined space to the suprapubic area. By injection of air into this tube the rubber collar around the urethra is distended and the urethra compressed. Release of the air removes the urethral obstruction.

One of these two patients has been followed for ten months and she is continent. At three-hour intervals the bladder is emptied with the rubber sphincter decompressed. Ten cc. of air is injected into the prosthesis and this prevents leakage of urine. This 12-year-old girl carries a 10 cc. syringe in her handbag so that the prosthesis can be reinflated after voiding. She is now going to school and has remained

dry. The prosthesis has been changed at two- to four-month intervals.

A similar operation has been successfully performed on a second patient. The follow up is shorter and it is now possible for him to stay dry for one and a half hour periods between voidings. As the bladder capacity increases it is hoped to gradually prolong this interval to three hours.

DISCUSSION

The treatment of cord bladder incontinence in children is complicated and requires vast persistence by the patient. It is impossible to predict at the outset of treatment how much will be required to make the patient dry. Consequently each patient has to be subjected to a set routine. First of all there must be a period of a year or more with a catheter and Munro irrigation before training is attempted. As complete cooperation is required the training is not attempted until the child is 10- to 12-years of age. The behavior of the bladder is determined by cystometrograms which are carefully performed, each one requiring two- to three-hours to complete. A constant recording of intravesical pressure during filling is made so that all bladder contractions are recorded. Most children with myelomeningocele will have hypertonic bladders with excessive intravesical pressure. Attempts to train children with such bladders is injurious for the intravesical pressure is virtually equal to the ureteral peristaltic pressure. In our small series Banthine® was uniformly effective in reducing the pressure to normal level and to eliminate most of the purposeless detrusor contractions. When cystometrogram tracings prove that Banthine® accomplishes these changes bladder training is safe and may be successful. Any residual volume of urine after attempted bladder emptying was increased by the use of this drug. Fortunately this can be eliminated by bladder neck resections. Despite all these maneuvers some children will continue to dribble and in them the pneumatic cuff can be successfully used as a voluntary sphincter.*

The key to the success of these maneuvers is to teach the child to empty the bladder by increasing intraabdominal pressure. Some find that manual suprapubic pressure is essential to augment the voluntary increased intraabdominal pressure. Several months of training supervised by devoted and persistent parents are required.

CONCLUSION

1. Some children with lumbar cord lesions have cord bladders similar to those observed in adults.
2. Continence can be achieved by the Munro technic in such children.
3. The majority of cord bladders in children with myelomeningoceles are hypertonic.
4. The intravesical hypertension can be controlled with Banthine.
5. Residual volumes of urine after emptying can be corrected by bladder neck resection.
6. After these measures had failed to achieve continence an artificial pneumatic sphincter has been useful.

BIBLIOGRAPHY

1. Munro, D. Care of the Back following Spinal Cord Injuries. A Consideration of Bed Sores. New England J. Med., 223: 391, 1940.
2. Munro, D. The Rehabilitation of Patients Totally Paralyzed Below the Waist, with Special Reference to Making Them Ambulatory and Capable of Earning Their Own Living. 2. Control of Urination. New England J. Med., 234: 207, 1946.
3. Munro, D. Rehabilitation of Veterans Paralyzed as the Result of Injury to the Spinal Cord and Cauda Equina. Am. J. Surg., 75: 3, 1948.

* This type of sphincter has been used in other conditions. These experiences will be the subject of a second report.